89. *A New Jurassic Mammalia from South Manchuria.*

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(Comm. by H. YABE, M.I.A., Nov. 12, 1938.)

The present paper deals with an interesting mammalian remain collected by Mr. G. Morita of the Manchurian Colliery Company, Sinkyô, from the Sakusiyô coal-field, 3.6 km east of the Station Gabôten on the Dairen-Harbin railway line, and 25 km north of Hihumi pass, Tyôzanzi-kai, from where Hayashi and Yabe[1] once reported the occurrence of *Plicatounio naktongensis manchuricus*. The mammalian and molluscan beds belong to two different Mesozoic complexes, brought near, after the new interpretation of Mr. Rinji Saito, by a great thrust.

After the typoscript of the paper on *Plicatounio* has been sent to press, Yabe received a communication from Mr. H. Ozaki, then geologist of the South Manchurian Railway Company, on the stratigraphy of the Mesozoic complex exposed at and near Hihumi pass, in which he kindly reported the information given to him by his colleague Mr. Kawada who named the Mesozoic formation the Tyôzanzi series.

The Tyôzanzi series which Kawada believes to be Cretaceous in age occupies an area covering the topographical map of the Kwantô leased territory 1:25,000 Sheet Tyôzanzi and its environs; northwards it extends to the vicinity of the town Gabôten, where it is apparently underlain discordantly by the Middle Jurassic coal series and older formations. The Tyôzanzi series consists, according to Kawada, of, in descending order:

Upper division
- Shale, interbedded with subordinate sandstone and conglomerate. 350 m.
- Sandstone, interbedded with subordinate conglomerate. 350 m.
- Conglomerate. 500 m.

Lower division
- Shale, interbedded with subordinate sandstone and conglomerate. *Plicatounio* and other molluscs found in the lowest part. 450–580 m.
- Sandstone, interbedded with subordinate tuffaceous shale and tuffaceous sandstone. A rolled boulder of silicified wood (*Protocedroxylon araucarioides* Gothan, according to the identification of Mr. M. Shimakura) once found in it. ca. 1,000 m.

Though continuous from the base to the top, the Tyôzanzi series comprises evidently two distinct cycles of sedimentation, each beginning with conglomerate, succeeded by sandstone and ending in shale.

The conglomerate at the base of the lower division is reddish brown to purple. Its boulders are usually smaller than 10 cm in diameter and the most prevailing size is 3 cm. Commonest of them are white or brownish quartzites; rarer are gneisses, green volcanics, gray limestone and oolitic limestone; the cement is reddish brown tuffaceous sand. The conglomerate has several thin layers of gray-

1) H. Yabe and Z. Hayasi: A Mesozoic Unionid from Manchuria. Jap. Jour. Geol. Geogr., XV, 31, 1938.

yellowish tuffaceous sandstone and reddish brown tuffaceous shale interbedded in it. A rolled boulder of silicified wood was found at Tiawo-kou, 11 km north of Tyôzanzi and identified by Mr. M. Shimakura with *Protocedroxylon araucarioides* which has a range from the Middle Jurassic to the Cretaceous.

The overlying sandstone which has a shale or instead a conglomerate in its middle part is yellowish or light greenish, medium-grained and compact; under the microscope it consists of angular grains of quartz, orthoclase, plagioclase and calcite, with additional fragments of hornblend and minute chloritic substances to which its colour is due.

The shale which rests on the sandstone is interbedded with subordinate sandstone and conglomerate; with increasing amount of the latter two, it turns out at Hihumi pass and several other places to a group of shale, sandstone and conglomerate in alternation. The shale is grayish yellow in the lower part, increasing in green tint upwards, until it becomes olive coloured in the uppermost part. The shale consists of fine grains of quartz and calcite, mixed with a considerable amount of chloritic substance. *Plicatounio naktongensis manchuricus* was obtained in the lowest part of the shale exposed at Hihumi pass; 2–3 m higher than the fossiliferous horizon, there is a layer of dark gray limestone, some 15 cm thick. So far is the information given by Ozaki.

In a letter received lately, Mr. G. Morita informs Yabe that he has once obtained *Campeloma* sp., *Onychiopsis elongata* (Geyler) and *Ruffordia*? sp. at an exposure near Hihumi pass; this fossiliferous deposit is probably of the same or nearly the same horizon with that which afforded *Plicatounio* to Kawada.

The geological structure around the Sakusiyô coal-field is complicated; after Saito's new interpretation, there exists a great thrust structure, with the basement composed of Lower and Middle Cambrian slate and limestone unconformably overlain by the Jurassic coal series of the coal-field, and the thrust sheet consisting of Pre-Cambrian phyllite and quartzite, unconformably overlain by a Cretaceous? conglomerate. This conglomerate with boulders of quartzite, andesite and porphyrite, beside subordinate ones of gneiss, phyllite, limestone and other older rocks is that which Ozaki referred to in his communication quoted above as the northern extension of the Tyôzanzi series.

The Jurassic coal series is exposed in geological windows and shows the following succession in descending order near the Sakusiyô colliery, after an information kindly supplied by G. Morita.

Middle Cambrian limestone
fault-contact
Sandstone and shale in alternation with 2 unworkable coal seams.
Sandstone and shale in alternation with a 1 m thick calcareous bed full of molluscan shells (*Corbicula*), so crowded to form shell-limestone (locally represented by marl). 7 m.
Shale with plant remains; *Equisetites*, *Ginkgoites* cf. *sibirica* (Heer), *Czekanowskia rigida* Heer, *Podozamites lanceolatus* (Lindley and Hutton), etc.
Sandstone with 2 main coal seams.

The mammalian remains and fish scales were found by him very close to the shell-limestone.

The whole complex is correlated by Morita with his "Husin series" in the Husin coal-field, where he has studied it with particular care. It is, he states, this formation which has an extensive distribution in Manchuria and Jehol, and has a characteristic flora once dealt with by S. Oishi and Yabe who claimed the Middle Jurassic age for it, while some authors tend to assume its Lower Jurassic age.

One of the mammalian remains found by Morita in the Sakusiyô coal series is a small, scarcely 3 cm long, right lower jaw with eight teeth in situ. It apparently represents a new type provisionally to be included in the family Amphidontidae. The other one is a scapula presumably of the same animal.

Family Amphidontidae Simpson, 1925 (?)

Genus *Manchurodon*, gen. nov.

Genotype: *Manchurodon simplicidens*, sp. nov.

Diagnosis: Symmetrodont, related to *Amphidon* Simpson, 1925. Dental formula I ? C ? Pm_{1-3} M_{1-5}. Lower molars functionally unicusped with basal cingulum and an accessory cuspule on posterior cutting edge, both more distinct than in *Amphidon*. P_3 and M_1 nearly equal in dimensions.

Manchurodon simplicidens, sp. nov.

Figs. 1–3.

Holotype: Right lower jaw, bearing cheek teeth and preserved in a slab of sandy shale together with a fragmental scapula, probably belonging to the same animal. Temporary stored in the Institute of the Geology and Palaeontology, Tôhoku Imperial University, later to be transfered to the Geological Department of the Central Museum of Manchoukuo, Sinkyô.

Locality: Sakusiyô coal-mines near Gabôten, South Manchuria.

Horizon: "Husin Series" of G. Morita; Middle Jurassic.

Characters of Holotype:

Lower jaw lacking symphysis, lower portion of horizontal ramus and greater part of ascending ramus; about 29.5 mm long. Inner face of ramus invisible; state of internal groove as well as coronoid or angular portion unknown. Horizontal ramus relatively high; rather short?, or in other case, provided with distinct diastema in front of first cheek tooth. Lower jaw, in general aspect, more resembling *Paurodon* than the Spalacothriidae.

Alveolar length of lower jaw 15 mm, without trace of socket or alveolar sheath born on anterior, some 5 mm long portion before first cheek tooth. Dentition PM_{1-3} M_{1-5}, in assuming first cheek tooth for PM_1, the space before it for diastema and last tooth set close to the anterior border of ascending ramus for M_5.

Excepting M_5 which is much damaged, all teeth functionally unicusped, without talonid, but with basal cingula and a cuspule on posterior cutting edge. Premolars sectoral, similar in shape to molars, but more pointed. PM_3 somewhat inferior to M_1 in size. Molars longer

The cheek teeth are twice as large as those of *Amphidon superstes* Simpson from the Upper Jurassic Morrison formation of Wyoming, United States of America, exceed those of the most Paurodonts and Spalacotherids, and approach those of *Tinodon* from the Morrison formation in size. In so far as the size of cheek teeth concerned alone, the present specimen corresponds with relatively advanced forms of the Spalacotheriidae and Pantotheres and is surpassed only by the Triconodontinae bearing in general relatively larger teeth.

It is regretable that the inner surface of crown is invisible; however, it is very likely that there is no distinct internal cusps in those teeth and for a while the present writers are inclined to assume them as having Amphidont form. The cuspule of M_3 is the largest of all and is close to basal cingulum, whereas that of M_1 and M_4 occupies a relatively higher position. If main cusp, accessory cusp, cuspule and basal cingulum of these teeth are represented by M, C, and c, b respectively and the symbols arranged anteroposteriorly then it follows:

PM_1	PM_2	PM_3	M_1	M_2	M_3	M^4	M^5
M	bMb	bMb	bMcb	bMc ? b	bMcb	bMcb	bM ?

or expressed shortly

3 bMb 5 bMcb

The teeth pattern of premolars and molars of some related Mesozoic mammals are given below for comparison.

Amphidon (Symmetrodonta)	4	M	4	bMb
Spalacotherium (Symmetrodonta)	3	cMc	4	bcMcb
Amphilestes (Triconodonta)	4	bMb	5	bCMCb
Triconodon (Triconodonta)	3-4	bMcb	3-4	CMC
Amphitherium (Pantothere)	4	Mb	7	CMc-C

where C represents an anterior or posterior cusp.

Relationship: This species is no doubt very different from the Triconodonta and Pantothere in essential features of teeth, which are very primitive in pattern, but progressed in respect to their size, being relatively large. The teeth pattern is unique, occupying a position somewhat intermediate between *Amphidon* and *Spalacotherium*.

A comparison of the present material with *Amphidon* and *Spalacotherium* of the Symmetrodonta leads one to suspect that the former apparently serves as a connecting link between the latter two in certain sense, as the bMcb pattern of its cheek teeth are intermediate between bMb of *Amphidon* and bcMcb of *Spalacotherium*. It may probably be included into the Symmetrodonta with the other two, though its molars are by no means strictly symmetrical as to the median transverse plane, and for a while the writers prefer to assign it to the Amphidontidae, on its great resemblance to *Amphidon* in general aspect of lower jaw and cheek teeth; at the same time it approaches considerably the Spalacotheriidae in dental formula and dimensions of teeth. In short, it represents, one can say, a form more progressive in the size of cheek teeth and less so in the specialization of cusps. It is very desirous to procure a better material of this very interesting type of the Mesozoic mammals for further study.

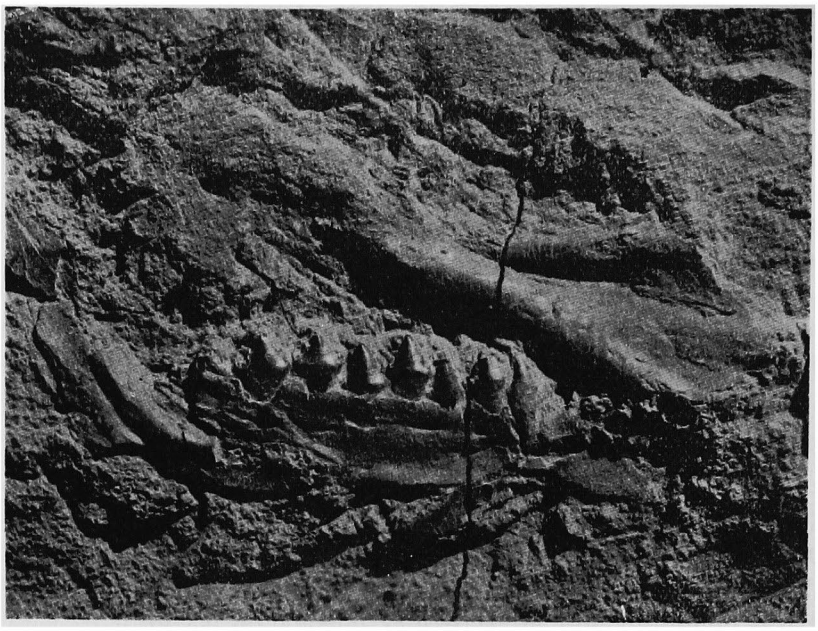

Figure 1.

Manchurodon simplicidens, right lower jaw, outside. ×3

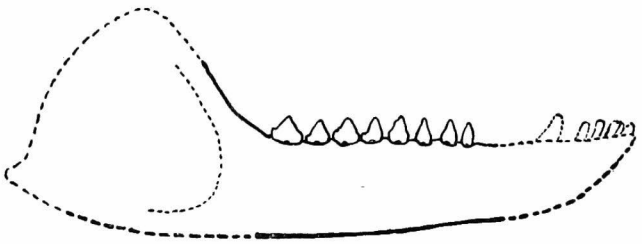

Figure 2.

Restored lower jaw of *Manchurodon simplicidens*.

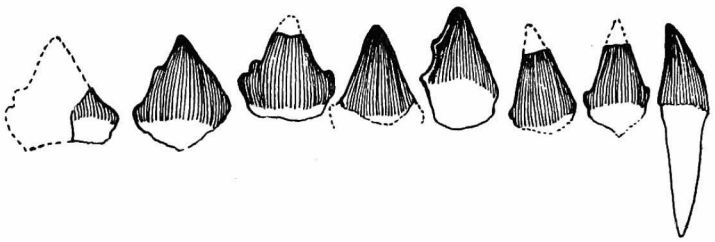

Figure 3.

Lower cheek teeth of *Manchurodon simplicidens* about 5.3× natural size.

than height, relatively longer than premolars, provided with a more distinct cuspule and basal cingulum than in premolars. Dimensions of cheek teeth are (in mm):

	PM_1	PM_2	PM_3	M_1	M_2	M_3	M_4	M_5
Length of crown	1.5	1.7	1.7	1.8	2.2	2.2	2.3	2.5
Height of crown	1.4	1.4	1.6	1.7	2.2	2	1.7	—